

PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY
(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

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| Applicant's or agent's file reference P17257WO1 | | FOR FURTHER ACTION See Form PCT/IPEA/416 | |
| International application No. PCT/SE 2004/000654 | International filing date (day/month/year) 26-04-2004 | Priority date (day/month/year) 25-04-2003 | |
| International Patent Classification (IPC) or national classification and IPC G01S 7/292, G01S 13/90 | | | |
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- This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
- This REPORT consists of a total of 4 sheets, including this cover sheet.
- This report is also accompanied by ANNEXES, comprising:
 - ☒ (sent to the applicant and to the International Bureau) a total of 4 sheets, as follows:
 - ☒ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
 - ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
 - ☐ (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) _____, containing a sequence listing and/or tables related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

- This report contains indications relating to the following items:

- | | | |
|-------------------------------------|--------------|---|
| <input checked="" type="checkbox"/> | Box No. I | Basis of the report |
| <input type="checkbox"/> | Box No. II | Priority |
| <input type="checkbox"/> | Box No. III | Non-establishment of opinion with regard to novelty, inventive step and industrial applicability |
| <input type="checkbox"/> | Box No. IV | Lack of unity of invention |
| <input checked="" type="checkbox"/> | Box No. V | Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement |
| <input type="checkbox"/> | Box No. VI | Certain documents cited |
| <input type="checkbox"/> | Box No. VII | Certain defects in the international application |
| <input type="checkbox"/> | Box No. VIII | Certain observations on the international application |

| | |
|---|--|
| Date of submission of the demand 11-11-2004 | Date of completion of this report 18-07-2005 |
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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/SE 2004/000654

Box No. I Basis of the report

1. With regard to the language, this report is based on:

- ☐ the international application in the language in which it was filed
- ☐ a translation of the international application into _____,
which is the language of a translation furnished for the purposes of:
- ☐ international search (Rules 12.3(a) and 23.1(b))
- ☐ publication of the international application (Rule 12.4(a))
- ☐ international preliminary examination (Rules 55.2(a) and/or 55.3(a))

2. With regard to the elements of the international application, this report is based on (replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):

- ☐ the international application as originally filed/furnished
- ☒ the description:
- pages 1 - 14 _____ as originally filed/furnished
- pages* _____ received by this Authority on _____
- pages* _____ received by this Authority on _____
- ☐ the claims:
- pages _____ as originally filed/furnished
- pages* _____ as amended (together with any statement) under Article 19
- pages* 1 - 4 _____ received by this Authority on 09-06-2005
- pages* _____ received by this Authority on _____
- ☒ the drawings:
- pages 1 - 6 _____ as originally filed/furnished
- pages* _____ received by this Authority on _____
- pages* _____ received by this Authority on _____
- ☐ a sequence listing and/or any related table(s) – see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages _____
- ☐ the claims, Nos. _____
- ☐ the drawings, sheets/figs _____
- ☐ the sequence listing (specify): _____
- ☐ any table(s) related to the sequence listing (specify): _____

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

- ☐ the description, pages _____
- ☐ the claims, Nos. _____
- ☐ the drawings, sheets/figs _____
- ☐ the sequence listing (specify): _____
- ☐ any table(s) related to the sequence listing (specify): _____

* If item 4 applies, some or all of those sheets may be marked "superseded."

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/SE 2004/000654

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

| | | | |
|-------------------------------|--------|-------------|-----|
| Novelty (N) | Claims | <u>1-14</u> | YES |
| | Claims | | NO |
| Inventive step (IS) | Claims | <u>1-14</u> | YES |
| | Claims | | NO |
| Industrial applicability (IA) | Claims | <u>1-14</u> | YES |
| | Claims | | NO |

2. Citations and explanations (Rule 70.7)

Documents cited in the international search report:

D1: US 5546085 A

D2: Lord R. et al 'Approaches to RF interference suppression for VHF/UHF synthetic aperture radar' In: COMSIG '98. Proceedings of the 1998 South African Symposium on Communications and Signal Processing, 7-8 Sept 1998, pp 95-100

D3: US 6166678 A

D4: US 6028549 A

The invention relates to a radar, especially a synthetic aperture radar, and the problem of predicting noise for suppressing radio frequency interference.

D1 discloses a radar unit comprising means for separating coherent radio-frequency interference from synthetic aperture data. Interference data is determined and subtracted from the radar data. The radar PRF is deliberately controlled to make it a submultiple of the television broadcast signal horizontal scan rate. See column 4, line 38- column 5, line 6.

D2 discloses RF interference suppression for VHF/UHF synthetic aperture radar comprising spectral estimation of the RFI tones and coherent subtraction. The described methods make use of a priori knowledge of the RFI environment, e.g. modulation bandwidth and duty factor of several stations. See Chapters I, II and III A, pages 95-96.

Documents D3-D4 represent the general state of the art.

However, the claims have been amended. Independent claims 1

.../...

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: BOX V

and 8 now specifies that

- the arbitrary waveform generator generates pulse-compressed chirps,
- the radar pulse is composed of at least a first segment and a second segment,
- the overall radar pulses vary from pulse to pulse so that the time between radar pulses is an integer divisor of the periodicity of the at least one RFI signal.

The cited documents represent the general state of the art.

The invention defined in the amended claims 1-14 is not disclosed by any of these documents.

The cited prior art does not give any indication that would lead a person skilled in the art to the claimed radar unit and method of adapting pulses transmitted from a radar unit. Therefore, the claimed invention is not obvious to a person skilled in the art.

Accordingly, the invention defined in claims 1-14 is novel and is considered to involve an inventive step. The invention is industrially applicable.

Amended claims

1. Radar unit comprising

an antenna, an arbitrary waveform generator (AWG 9) issuing an arbitrary (peri-
5 odic) radar waveform signal at a given pulse repetition frequency (PRF), the AWG
unit being adapted for adjusting the phase of the radar waveform signal as a func-
tion of a phase adjustment signal,

a transmit amplifier (TX) coupled to the antenna,

a receive unit (RX) coupled to the antenna,

a 2D filter for generating associate values of radar response and coordinate data,

at least a noise prediction means coupled the receiver for receiving at least one
15 prevalent radio frequency interference (RFI),

a demodulation and decoding bank (10) comprising known information on the
modulation and coding principle of the prevalent RFI signal, the RFI signal typically
20 operating according to a predetermined refresh frequency at which redundant in-
formation is repeated (50Hz),

the noise prediction means (3, 4, 5, F1, 7, 12) receiving, demodulating and decod-
ing the information content of the at least one RFI signal, wherein

the arbitrary wave generator (9) is adapted for generating pulse-compressed
chirps, whereby

the arbitrary wave generator is controlled to produce an overall radar pulse com-
posed of at least a first segment (C2A) and a second segment (C2B) whose time /
30 frequency rates may differ from one another,

whereby the overall radar pulses vary from pulse to pulse such that for the coincid-
ing frequency (60) of the at least one RFI signal, the time (K) between radar pulses
35 is an integer divisor of the periodicity of the at least one RFI signal.

- ✓
- 5 2. Radar unit according to claim 1, wherein the overall pulse (C2A, C2B) composed of the first and second segment is formed so in relation to a previous radar pulse (C1), that the frequency range is the same as the frequency range of the previous pulse (C1) and the duration of the overall pulse is the same as the duration of the previous pulse (C1).
- 10 3. Radar unit according to any preceding claim, wherein radar pulses constitute linearly frequency modulated (FM) segments of differing time / frequency rates.
- 15 4. Radar unit according to claim 1, wherein the frequency spectrum is divided into a plurality of sub-channels, each sub-channel corresponding to a regulatory radio channel used for one radio or television information source, the radar unit comprising a noise prediction means for each RFI sub-channel overlapping with the radar range.
- 20 5. Radar unit according to claim 4, wherein the overall pulse (C2A, C2B)) is formed so that the composite transmit radar pulses varies from pulse to pulse such that for the coinciding frequency of each RFI signal, the time between radar pulses (K) is an integer divisor of the periodicity of each corresponding RFI signal.
- 25 6. Radar unit according to any preceding claim, wherein radar pulses constitute linearly frequency modulated (FM) segments.
- 30 7. Radar unit according to claim 6, wherein the radar pulses are temporarily disjunct.

8. Method of adapting pulses transmitted from a radar unit, comprising the steps of

- receiving and demodulating at least one prevalent RFI signal,

5 - sensing the periodicity (K) of a component (35, 37, 36, 38) of the at least one prevalent RFI signal having a given RFI frequency (60) coinciding with a frequency of the radar pulses,

10 - the arbitrary wave generator (9) is generating pulse-compressed chirps, whereby

the arbitrary wave generator is controlled to produce an overall radar pulse composed of at least a first segment (C2A) and a second segment (C2B) whose time / frequency rates may differ from one another,

15 whereby the overall radar pulses vary from pulse to pulse such that for the coinciding frequency (60) of the at least one RFI signal, the time (K) between radar pulses is an integer divisor of the periodicity of the at least one RFI signal.

20 9. Method according to claim 8, wherein the overall pulse (C2A, C2B) composed of the first and second segment is formed so in relation to a previous radar pulse (C1), that the frequency range is the same as the frequency range of the previous pulse (C1) and the duration of the overall pulse is the same as the duration of the previous pulse (C1).

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10. Method according to any of claims 8-9, wherein radar pulses constitute linearly frequency modulated (FM) segments of differing time / frequency rates.

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11. Method according to claim 8 or 9, wherein the frequency spectrum is divided into a plurality of sub-channels, each sub-channel corresponding to a regulatory radio channel used for one radio or television information source, the radar unit comprising a noise prediction means for each RFI sub-channel overlapping with the radar range.

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12. Method according to claims 8 -11, wherein the overall pulse (C2A, C2B)) is formed so that the composite transmit radar pulses varies from pulse to pulse such that for the coinciding frequency of each RFI signal, the time between radar pulses (K) is an integer divisor of the periodicity of each corresponding RFI signal.

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13. Method according to any preceding claims 8 - 12, wherein radar pulses constitute linearly frequency modulated (FM) segments.

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14. Method according to any preceding claims 8 - 13, wherein the periodicity of the RFI signal corresponds to the frame periodicity or line periodicity of a television signal.

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